**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re Patent Application of

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For: OPTICAL PICKUP HAVING TWO WAVELENGTH LASER AND SIMPLE STRUCTURE

## TRANSLATOR'S DECLARATION

Honorable Commissioner of Patents
and Trademarks
Washington, D.C. 20231

Sir:

I, Satoko Akatsuka, of 79-3, Kumagawa, Fussa-shi, Tokyo, Japan hereby certify that I am conversant with both the Japanese and the English languages, and that I have prepared the English translation attached hereto, which is a full, true and faithful translation of the patent application filed with the Patent Office of Japan under Application No. 111988/2000 on April 13, 2000 to the best of my knowledge and belief.

I further declare that all statements made in this declaration of my own knowledge are true and that all statements made on information and belief and believed to be true; and further, that these statements are made with the knowledge that willful, false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful, false statements may jeopardize the validity of this application or any Patent issued thereon.

December 20, 2004
Date

Name: Satoko AKATSUKA

[Name of Document] SPECIFICATION

[Title of the Invention] Optical Pickup

[Claims]

[Claim 1] An optical pickup comprising:

a two-wavelength laser having two light sources arranged to be adjacent to each other to emit two laser beams different from each other in wavelength to the same direction;

a polarizing beam splitter partially passing or reflecting laser beam emitted from said two-wavelength laser to an optical disc and partially reflecting or passing the returning laser beam to a predetermined direction; and

a photo detector having a photo sensing area pattern for receiving two returning laser beams originated from said two light sources on the photo sensing area so as to detect the returning laser beam from said polarizing beam splitter to said predetermined direction.

[Claim 2] An optical pickup as claimed in claim 1, wherein said photo sensing pattern is formed by three photodiodes.

[Claim 3] An optical pickup as claimed in claim 2, wherein at least one of said three photodiodes has two photo sensing areas for receiving the returning laser beam of laser beam from said two light sources, respectively.

[Claim 4] An optical pickup as claimed in claim 3, wherein said two photo sensing areas included in any one of said three photodiodes serves as a fourfold photodiode.

[Detailed Description of the Invention]

[0001]

[Field of the Invention]

This invention relates to an optical pickup, in particular, to improvement of a two-wavelength correspondence optical pickup having two-wavelength laser.

[0002]

[Prior Art]

As is well known in the art, there exists a DVD (digital video disc) device having a special optical pickup to permit playing both of DVD and CD (compact disc). Such kind of special optical pickup reproduces by using two kinds of laser beams appropriately, namely, a shorter wavelength laser beam having a wavelength of about 650nm for DVD, and a longer wavelength laser beam having a wavelength of about 780nm for CD. This special optical pickup is called two-wavelength correspondence optical pickup.

[0003]

Referring to Fig. 3, description will be made about a conventional two-wavelength correspondence optical pickup as follows. Fig. 3 is a system construction diagram of an optical system of the two-wavelength correspondence optical pickup.

[0004]

The two-wavelength correspondence optical pickup as shown in the drawings comprises first and second laser diodes LD1 and LD2, first and second gratings GRT1 and GRT2, first and second polarizing beam splitters PBS1 and PBS2, collimating lens CL, a rising mirror (or a 45 degree mirror) FM, object lens OL, and a photo detector PD.

[0005]

The first laser diode LD1 is a laser diode for emitting a first laser beam having a wavelength of about 650 nm for playing a DVD, and is called as a DVD-LD. The second laser diode LD2 is a laser diode for emitting a second laser beam having a wavelength of about 780 nm for playing a CD, and is called as a CD-LD. The first grating GRT1 divides the first laser beam from the first laser diode LD1 into three laser beams (i.e. a central beam and two side beams located on both sides of the central beam). Similarly, the second grating GRT2 divides the second laser beam from the second laser diode LD2

into three laser beams.

[0006]

The first polarizing beam splitter PBS1 reflects three laser beams from the first grating GRT1, and passes returning laser beams, namely, the reflected laser beams from an optical disc DISC as mentioned later. The second polarizing beam splitter PBS2 reflects three laser beams from the second grating GRT2, passes three laser beams from the first polarizing beam splitter PBS1, and emits in a direction of the collimating lens CL. In addition, the second polarizing beam splitter PBS2 passes the returning laser beams (or reflected laser beams from the optical disc DISC) as mentioned later. The second polarizing beam splitter PBS2 is arranged so that optical axes of the first laser beam emitted from the first laser diode LD1 coincides with that of the second laser beams emitted from the second laser diode LD2.

[0007]

The collimating lens CL collimate three laser beams from the second polarizing beam splitter PBS2 to parallel laser beams. The rising miller FM reflects the parallel laser beams from the collimating lens CL at a right angle to lead the parallel laser beams to the object lens OL. The object lens OL irradiate the parallel laser beams reflected by the rising miller FM on the optical disc DISC.

[0008]

The reflected laser beams reflected on the optical disc DISC (returning laser beams) are received on a photo detector PD as mentioned later.

[0009]

Here, the first polarizing beam splitter PBS1 has a reflectance of about 50% and a transmissivity of about 50% for light having a wavelength of about 650 nm, and has a transmissivity of 100% for light having a wavelength of about 780 nm. On the other hands, the second polarizing beam splitter PBS2 has a transmissivity of 100% for light having a wavelength of about 650 nm,

and has a reflectance of about 50% and a transmissivity of about 50% for light having a wavelength of about 780 nm. Therefore, the luminous power of about 25% of the laser beams emitted from the first and the second laser diodes LD1 and LD2 enters to the photo detector PD. Even if the luminous power is decreased to be about 25%, the photo detector PD fully operates and can fulfill its function.

[0010]

Next, the description will be made about an operation of the optical pickup of Fig. 3. The explanation will be made about an operation where the optical disc DISC is DVD at first, and then about an operation where the optical disc DISC is a CD.

[0011]

When the optical disc DISC is the DVD, only the first laser diode LD1 (DVD-LD)is in an operation state, while the second laser diode LD2 (CD-LD) is not in an operation state. Accordingly, the first laser diode LD1 alone emits the first laser beam L1.

[0012]

The first laser beam L1 emitted from the first laser diode LD1 is divided into three laser beams in the first grating GRT1 and enter the first polarizing beam splitter PBS1. The three laser beams entering the first polarizing beam splitter PBS1 are reflected on its reflecting surface, and passed the second polarizing beam splitter PBS2, collimated by the collimating lens CL, reflected by the rising miller FM at a right angle, condensed by the object lens OL, and irradiated on a recording layer of the optical disc DISC (DVD).

[0013]

The reflected laser beams (returning laser beams) from this recording layer of DVD again pass the second polarizing beam splitter PBS2 and the first polarizing beam splitter PBS1 through the object lens OL, the rising mirror FM, and the collimating lens CL, and enter the photo detector PD.

[0014]

Next, when the optical disc is CD, only the second laser diode LD2 (DC-LD) is in an operation state, while the first laser diode LD2 (DVD-LD) is not in an operation state. Accordingly, the second laser diode LD2 alone emits the second laser beam L2.

[0015]

The second laser beam L2 emitted from the second laser diode LD2 is divided into three laser beams in the second grating GRT2 and enter the second polarizing beam splitter PBS2. The three laser beams entering the second polarizing beam splitter PBS2 are reflected on its reflecting surface, collimated by the collimating lens CL, reflected by the rising miller FM at a right angle, condensed by the object lens OL, and irradiated on a recording layer of the optical disc (CD).

[0016]

The reflected laser beams (returning laser beams) from this recording layer of CD again pass the second polarizing beam splitter PBS2 and the first polarizing beam splitter PBS1 through the object lens OL, the rising mirror FM, and the collimating lens CL, and enter the photo detector PD.

[0017]

Fig. 4 shows a photo sensing pattern of the photo detector PD. The optical disc device such as DVD player reproduces the optical disc DISC by using the laser beam, so that focusing control and tracking control are indispensable. To carry out the focusing control, it is necessary to process the reflected laser beams (returning laser beams) from the optical disc DISC and to produce a focus error signal. In order to carry out the tracking control, it is necessary to process the reflected laser beams and to produce the tracking error signal.

[0018]

In the optical disc device, as mentioned above, the laser beam emitted from the laser diode which is light sources pass the grating and are divided into three laser beams which are different in fractional angle each other. Therefore, the reflected laser beams (returning laser beams) from the optical disc DISC also consists of three laser beams. In these laser beams, the central laser beam is used for producing a reading signal and the focus error signal. The remaining two side beams are used for producing the tracking error signal.

[0019]

As illustrated in Fig. 4, the photo detector PD for receiving the reflected laser beams comprises a fourfold photodiode 31 for receiving the central laser beams and producing the first through fourth reception signals, and a pair of photo diodes 32, 33 disposed with a relative distance from this fourfold photodiode, receiving the two side beams and producing the fifth and sixth reception signal.

[0020]

When the central laser beam is exactly condensed on the pit surface of the optical disc DISC, formation of the returning laser beams is not affected by the optical system, and a beam spot has a circle on the surface of the fourfold photodiode 31. On the other hands, the optical system makes the beam spot of the returning laser beams ellipse in shape because the distance between the object lens OL and the optical disc DISC increases or decreases.

[0021]

The three laser beams divided by the grating make three spots on the pit surface of the optical disc DISC. The two side laser beams, which are two of the reflected, returning laser beams affected by the pits, are focused on the photo sensing area of the pair of photo diodes 32, 33.

[0022]

The optical disc device comprises a processing circuit (not shown) for processing the first through the fourth reception signals from the fourfold

photodiode 31 and the fifth and sixth reception signals from the pair of photo diodes 32, 33. This processing circuit comprises a first signal processing unit (not shown) for processing the first through the fourth reception signals and producing the reading signal and the focus error signal, and a second signal processing unit (not shown) for processing the fifth and sixth reception signals and producing the tracking error signal.

[0023]

[Problems to be Solved by the Invention]

As mentioned above, the conventional two-wavelength correspondence optical pickup has the first laser diode LD1 for the DVD and the second laser diode LD2 for the CD as a separate parts each other. Therefore, it is a problem that there is provided two gratings and two polarizing beam splitters, and its structure becomes complicated.

[0024]

It is an object of the present invention to provide an optical pickup for use in a DVD player which is simple in structure, small in manufacture steps, low in cost, and improved in reliability.

[0025]

Japanese Unexamined Patent Publications No. 11-144284 and No. 11-149652 disclose a one-chip structure of the first laser diode and the second laser diode for the purpose of reduction of components and cost. (Hereinunder, it is called as a one-chip laser diode) Japanese Unexamined Patent Publication No. 11-144284, however, never discloses a structure for detecting two laser beam sets by a common photo detector. On the other hands, Japanese Unexamined Patent Publication No. 11-149652 discloses a structure for detecting two laser beam sets by a common photo detector, however, never discloses the structure for actual use as the two-wavelength correspondence optical pickup. Specifically, this publication never discloses the gratings for dividing and irradiating the laser beams. In addition, although

the two sets of returning laser beam are never returned on the same axis, there is no disclosure of the specific means for detecting by the common photo detector. (In Japanese Unexamined Patent Publication No. 11-149652, there is disclosed that the laser beam enters in a right angle to the optical disc by using hologram elements where two laser diodes are arranged apart from each other. However, it is not considered that the two sets of laser beam are apart from each other. In addition, the actual one-chip laser diode has two laser diodes arranged with a distance of about 100 $\mu$ m apart from each other. Such a distance is indispensable.)

[0026]

[Means for Solving the Problems]

According to the present invention, there is provided an optical pickup comprising two-wavelength laser (Fig. 1, 11) having two light sources arranged to be adjacent to each other to emit two laser beams different from each other in wavelength to the same direction, a polarizing beam splitter (Fig. 1, 12) partially passing or reflecting the laser beam emitted from the two-wavelength laser to a optical disc and partially reflecting or passing the returning laser beam to a predetermined direction, and a photo detector (Fig. 17) having a photo sensing area pattern for receiving two returning laser beams originated from the two light sources on the photo sensing area so as to detect the returning laser beam from the polarizing beam splitter to the predetermined direction.

[0027]

More specifically, the above-mentioned photo sensing pattern consists of three photo diodes (Fig. 2, 21, 22, 23).

[0028]

Each of the three photo diodes comprises a photo sensing area for receiving the returning laser beams from the above-mentioned two light sources.

[0029]

Furthermore, the photo sensing area of any one of the three photo diodes can serve as the fourfold photodiode.

[0030]

[Mode of Embodying the Invention]

With reference to the drawings, description will be made in detail about embodiments of the present invention.

[0031]

Fig.1 shows a system construction diagram of an optical system of the two-wavelength correspondence optical pickup in accordance with one embodiment of the present invention.

[0032]

The two-wavelength correspondence optical pickup as shown comprises a two-wavelength laser 11, a grating (GRT) 12, a polarizing beam splitter (PBS) 13, collimating lens (CL) 14, a rising mirror (FM) 15, object lens (OL) 16, and a photo detector (PD) 17.

[0033]

The two-wavelength laser 11 includes a semiconductor chip on which first and second laser diodes are integrated, and the first laser diode emits a first laser beam L1 having a wavelength for DVD of about 650nm, and the second laser diode emits a second laser beam L2 having a wavelength for CD of about 780nm. The distance between the first laser diode and the second laser diode (namely, a distance between their luminous points) is equal to about 100 $\mu$m and can be made with precision of 1 $\mu$m.

[0034]

The grating 12 divides conventionally the laser beam from the two-wavelength laser 11 into three laser beams.

[0035]

The polarizing beam splitter 13 reflects and passes the first and the

second laser beams, for example, at a rate of 50 percent and at a rate of 50 percent, respectively. The laser beam entering the polarizing beam splitter 13 from the grating 12 is reflected at a rate of 50 percent toward the collimating lens 14 regardless of whether the laser beams are originated from the first laser beams or the second laser beams. In addition, the returning laser beams as mentioned later is passed at a rate of 50 percent toward the photo detector 17 regardless of whether the laser beams are originated from the first laser beams or the second laser beams.

[0036]

The collimating lens (CL) 14 collimates the laser beams reflected from the polarizing beam splitter 13 to form parallel beams and lead the laser beams to the rising mirror 15. The rising mirror 15 reflects the parallel beams from the collimating lens 34 and changes a traveling direction of the laser beams at an angle of 90 degrees to lead the laser beams to the object lens 16. The object lens 16 condenses the entering laser beams on the recording layer of the optical disc (DISC) 18. The laser beams reflected from the optical disc 18 returns as returning laser beams to the polarizing beam splitter 13 through the object lens 16, the rising mirror 15 and the collimating lens 14. The collimating lens 14, the rising mirror 15 and the object lens 16 are the same as the conventional ones.

[0037]

The photo detector 17 detects the returning laser beams passing the polarizing beam splitter and produces electrical signals in response to the optical strength of the returning laser beams. As shown in Fig. 2, the photo detector 17 comprises the photodiode 21 for receiving the center laser beam of the three laser beams, and the photodiodes 22 and 23 for receiving the two side laser beams of the returning laser beams.

[0038]

The photodiode 21 has photo sensing area 21a for detecting the

returning laser beams of the first laser beam and photo sensing area 21b or detecting the returning laser beams of the second laser beam, and these photo sensing areas include a common area 21c and are integrally composed. Furthermore, each of these sensing areas serves as the fourfold photodiode.

[0039]

This photodiode 21 can switch operation areas of the photodiode, for example, by means of a changeover switch in accordance with the situations, namely, a case for detecting the returning laser beams of the first laser beams in the photo sensing area 21a, and a case for detecting the returning laser beams of the second laser beam at the photo sensing area 21b. Specifically, when the returning laser beams of the first laser beams are detected, only the photo sensing area 21a operates. When the returning laser beams of the second laser beams are detected, only the photo sensing area 21b operates.

[0040]

Photodiodes 22 and 23 are capable of comprising the photo sensing area for detecting the returning laser beams of the first laser beam and the photo sensing area for detecting the returning laser beams of the second laser beam which are integrally composed like the photodiode 21. However, it is unnecessary to provide such composition because these photodiodes 22 and 23 are for detecting the luminous power of the side laser beam.

[0041]

Next, an operation of the optical pickup is described.

[0042]

The two-wavelength laser 11 drives the first laser diode when the optical disc 18 is DVD, and drives the second laser diode when the optical disc 18 is CD. Since these diodes are arranged apart from each other with a distance of about 100 $\mu$ m, the first laser beam L1 and the second laser beam L2 have optical axes (a center axis of the laser beam) which are parallel to each other and which are distant from each other in the horizontal direction.

[0043]

The laser beams L1 and L2 emitted from the two-wavelength laser 11 are divided into three laser beams by the grating 12, and enter the polarizing beam splitter 13. The polarizing beam splitter 13 partially passes the emitted laser beams L1 and L2 (in a downward direction of the drawing) and reflects remains. The laser beams passed through the polarizing beam splitter are not used thereafter. On the other hand, the laser beams L1 and L2 reflected by the polarizing beam splitter 13 are collimated by the collimating lens 14, reflected by the rising mirror 15, condensed by the object lens 16, and irradiated on the recording layer of the optical disc 18.

[0044]

The optical disc 18 reflects the laser beams L1 or L2 in accordance with information formed on the recording layer. The reflected laser beam from the recording layer of the optical disc 18 again enters the polarizing beam splitter 13 as the returning laser beams through the object lens16, the rising mirror 15, and the collimating lens 14.

[0045]

The polarizing beam splitter 13 reflects partially the returning laser beams from the collimating lens 14, and passes the remains and inputs into the photo detector 17.

[0046]

The photo detector 17 detects the returning laser beams by the photodiodes 21a, 22 and 23 when the returning laser beams are originated from the first laser beam. The photo detector 17 detects the returning laser beams by the photodiodes 21b, 22 and 23 when the returning laser beams are originated from the second laser beam. The photo detector 17 produces the electrical signals in response to the optical strength of the returning laser beams.

[0047]

In accordance with the above-mentioned embodiments, the polarizing beam splitter 13 has a structure for reflecting the laser beam emitted from the two-wavelength laser 11 on the side of the optical disc 18, and passing the returning laser beams on the side of the photo detector 17. The altemative structure may be available which changes locations of the two-wavelength laser 11 and the photo detector 17 each other, and passes the laser beams from the two-wavelength laser 11 to the side of the optical disc 18 and reflects the returning laser beams to the side of photodiode 17.

[0048]

It may also possible to arrange a cylindrical lens (SL) between the polarizing beam splitter 13 and the photo detector 17, and to improve the detecting precision in the photo detector 17 by extending the returning laser beams from the polarizing beam splitter 13 in an axis direction.

[0049]

Furthermore, in the above-mentioned embodiment, two laser diodes are formed so that the two laser beams which are emitted from the two-wavelength laser 11 and are different in wavelength becomes parallel each other, however, it is not necessary that laser beams emitted from the laser diodes should be parallel. For example, when the two laser beams emitted from the two-wavelength laser 11 cross each other, it is capable of detecting the returning laser beams by using the common photo detector in a same matter as the above-mentioned embodiment, if crossing is made on the entering surface of the collimating lens (cross section of each laser beam coincide).

[0050]

[Effects of the Invention]

As described above, according to the present invention, the optical pickup can detect the returning laser beams by the single photo detector regardless of the wavelength of the laser beam emitted from the two-wavelength laser, by using the two-wavelength laser and the single

polarizing beam splitter. As a result, the optical pickup has a simple construction, and thereby becomes small in manufacturing steps and low in cost, and improves its reliability.

[Brief Description of Drawings]

[Fig. 1]

A system construction diagram of an optical system of a two-wavelength correspondence optical pickup according to the embodiment of the present invention.

[Fig. 2]

A diagram for describing a photo detector of the two-wavelength correspondence optical pickup in Fig. 1.

[Fig. 3]

A system construction diagram of an optical system of a conventional two-wavelength correspondence optical pickup.

[Fig. 4]

A diagram for describing a photo detector of the two-wavelength correspondence optical pickup in Fig. 2.

[Description of Reference Numerals]

11 a two-wavelength laser

12 a grating (GRT)

13 a polarizing beam splitter (PBS)

14 collimating lens (CL)

15 a rising mirror (FM)

16 object lens (OL)

17 a photo detector (PD)

18 an optical disc

21, 22, 23 a photodiode

21a, 21b a photo sensing area

21c a part of a photo sensing area

31 a fourfold photodiode

32, 33 a photodiode

[Name of Document] ABSTRACT

[Summary]

[Object]

To simplify a structure of an optical pickup, and thereby provide the optical pickup which is small in manufacture steps, low in cost, and improved in reliability.

[Solving Means]

The use is made of a two-wavelength laser 11 which can emit a laser beam both for DVD and CD, and one of the laser beams is irradiated to the optical pickup through a grating 12, a polarizing beam splitter 13, collimating lens 14, a rising mirror 15, and object lens 16. Returning laser beams from the optical pickup enters a photo detector 17 through the object lens, the rising mirror, the collimating lens, and the polarizing beam splitter. The photo detector comprises three photodiodes 21, 22 and 23, which have a photo sensing area 21a for receiving the returning laser beams of the laser beam for DVD, and a photo sensing area 21b for receiving the returning laser beams of the laser beam for CD.

[Selected Figure] Fig. 1

[Selected Figure] Fig. 2